Crescent Creek at Vernhardson St – Fish Passage and Restoration Assessment

Waterfall Engineering, LLC

3/28/15

Crescent Creek is a tributary Gig Harbor. The drainage area is 5.6 square miles. The high fish passage design flow for a Level B analysis is 88 cfs. The 2-year flood flow is 218 cfs, and the 100-year flood flow is estimated at 502 cfs. The creek flows through a concrete box culvert under Vernhardson St. The culvert is a 6' x 6' concrete box, 110 feet long. The slope is 2.4 percent. The downstream end of the culvert is at tidal elevation 3.5 and the upstream end elevation 6.0 (approx.). When the tide is low a gravel channel maintains a backwater elevation of about 4.5 at the culvert outlet so there is no outlet drop. There is 8 feet of cover over the top of the culvert.

Velocities were measured in the culvert on 3/26/15 from 10:30 am to 12:30 pm. The tide was 7.5 at 10:30 and was outgoing. The flow was 11 cfs. Velocities in the culvert ranged from 1 fps when the culvert was backwatered to 6 fps in sections of the culvert which were not backwatered. The water depth varied from one to 0.3 feet.

For adult fish passage at low flow, the culvert becomes backwatered to meet fish passage depth and velocity criteria at an approximate tidal elevation of 7.0 (see Figure 1). It appears fish do have access to the culvert over the tides flats to pass at low flow. At the high fish passage design flow of 88 cfs the culvert does not meet fish passage criteria until a tidal backwater of 9.8 feet is exceeded. A tide of 7.0 is exceeded 50% of the time and a tide of 9.8 is exceeded only 20% of the time. Mean Higher High Water is 12.1 tidal elevation. Based on these very preliminary calculations the culvert does not meet WDFW fish passage criteria for adult salmon and trout, where passage 90 percent of the time is the standard.

In addition to adult fish passage, there are two other potential fish habitat impacts from this culvert, 1) juvenile fish passage from fish rearing in the estuary trying to use the habitat upstream of the culvert, and 2) frequent channel instability upstream due to the perched culvert and channel aggradation. This also reduces the amount of water that exchanges through a tidal cycle. There is currently a 4 foot vertical elevation difference from the channel upstream to downstream of the culvert. Without the culvert the channel upstream would be deeper with potentially more complex stable habitat.

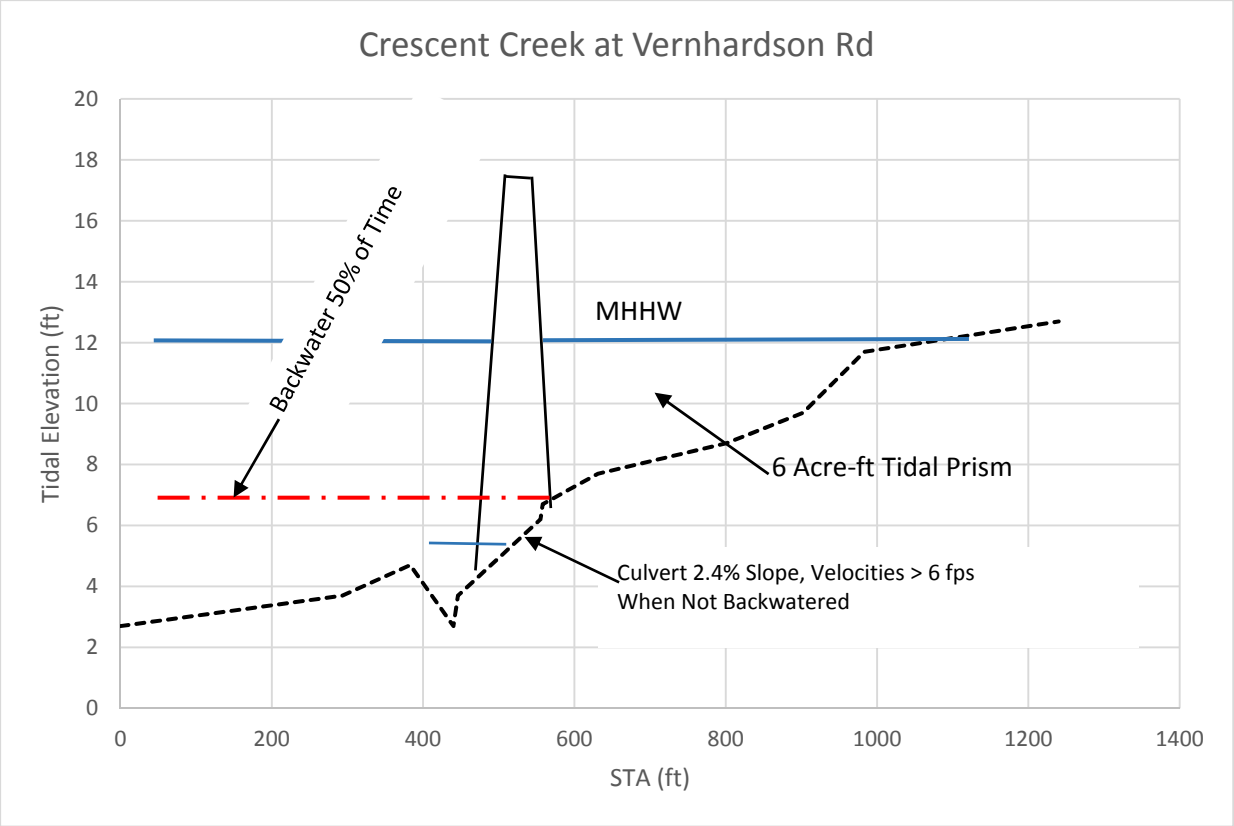


*Figure 1 – Profile of Crescent Creek and culvert at 96th St NW near Gig Harbor based on LiDAR data converted to Tidal Datum.*

Project: Cresent Creek
Designer: Waterfall Engineering
Date: 3/28/2015

Regression Equations for Region 1 $Q = a A^b P^c$ $Q = a A^b I^c$

| | | |
|---|---|---|
| Rainfall Intensity | 2.44 | inches per 24 hours |
| Annual Rainfall | 50 | inches per year |
| Drainage Area | 5.57 | square miles |

| | Flow (cfs) | + 1 SE | - 1 SE |
|---|---|---|---|
| $Q_{fp}$(May) | 23 | 30 | 16 |
| $Q_{fp}$(Jan) | 88 | 111 | 65 |
| $Q_2$ | 218 | 288 | 148 |
| $Q_{10}$ | 338 | 449 | 226 |
| $Q_{25}$ | 397 | 532 | 262 |
| $Q_{50}$ | 448 | 609 | 287 |
| $Q_{100}$ | 502 | 687 | 316 |

**Channel Width Calculated From: Castro and Jackson 2001**

*Based on Pacific Northwest Streams*
Width (ft) Based on DA: 23

*Based on Pacific Maritime Streams*
Width (ft) Based on DA: 26

**Channel Width Based on WDFW new Water Crossing Guidelines**

$W_{ch} = 0.95*WA^{0.45}AAP^{0.61}$ 22

| | |
|---|---|
| $Q_{fp}$(May) | Fish passage design flow for May |
| $Q_{fp}$(Jan) | Fish passage design flow for January |
| $Q_2$ | Two year peak flood flow in cfs |
| A | Drainage area in square miles |
| a,b,c | Regression constants from table below |
| I | Rainfall Intensity (in/24 hours) |
| P | Annual Rainfall (in/year) |
| SE | Standard Error |

Regression coefficients

| | a | b | c | SE(%) |
|---|---|---|---|---|
| $Q_{fp}$(May) | 2.250 | 0.850 | 0.95 | 30.6% |
| $Q_{fp}$(Jan) | 6.990 | 0.950 | 1.01 | 25.7% |
| $Q_2$ | 0.350 | 0.923 | 1.24 | 32.0% |
| $Q_{10}$ | 0.502 | 0.921 | 1.26 | 33.0% |
| $Q_{25}$ | 0.590 | 0.921 | 1.26 | 34.0% |
| $Q_{50}$ | 0.666 | 0.921 | 1.26 | 36.0% |
| $Q_{100}$ | 0.745 | 0.922 | 1.26 | 37.0% |

References: 1. Fish Passage Design Flows for ungaged catchments in Washington
(Powers and Saunders, 1998)

2. Magnitude and Frequency of Floods in Washington
(Sumioka, Kresch and Kasnik, 1998)